Lat 40.54789 and Lon -120.80729

Forest Health Protection
Pacific Southwest Region

Date: May 16, 2013

File Code: 3420

To: District Ranger, Eagle Lake RD, Lassen National Forest

Subject: Cottonwoods Next to Merrill CG-Amphitheater Trail (FHP Report #NE13-11)

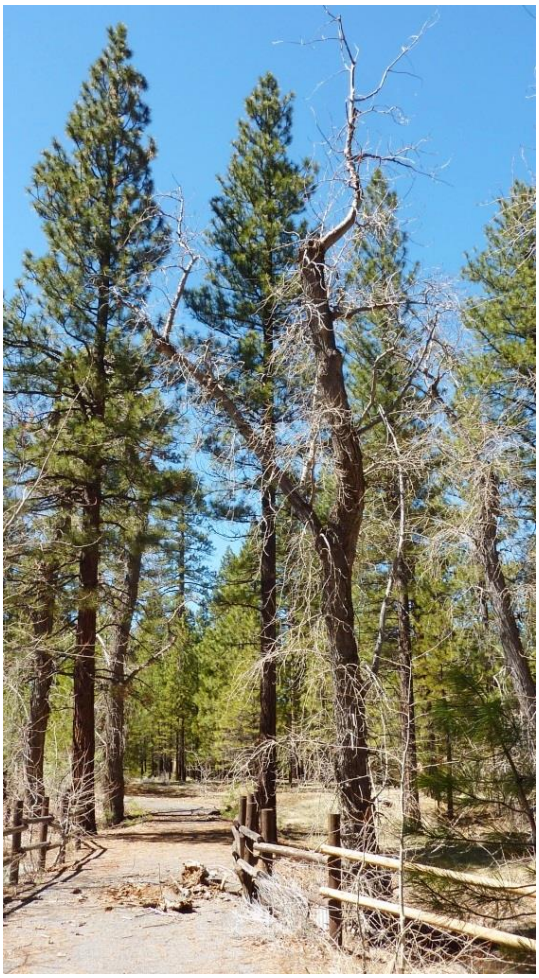

Figure 1. During winter 2012-2013 the top of this cottonwood separated and fell into the trail crossing Merrill Creek.

On a recent visit to Merrill Campground with Rick Crowther, District Small Sales Officer, Bill Woodruff, FHP Plant Pathologist observed large branch and bole sections from two cottonwood trees laying on the Merrill CG-to-Amphitheater trail at the Merrill Creek culvert. Had either of these sections struck a person, serious injury or death could have occurred. The larger of the sections (Figures 1 & 2) recently fell from near the top of a 38" DBH cottonwood sometime last winter and struck and broke two wooden rails of the fence on the north side of the trail (Figure 2). The smaller section (Figure 3) fell onto the trail approximately 50' west of larger section. Both sections were of sufficient size and weight to have resulted in serious injury or death had they fallen on a person. This site is located in SE¼ NE ¼ Sec. 14 T31N, R10E, Mt. Diablo Meridian; Latitude 40.556382; Longitude -120.775110). It is 95 feet from a 24 inch DBH Jeffrey pine tree that blew down late in 2011 revealing extensively decayed roots (Figure 2) which tested positive for DNA of the fungus *Heterobasidion* spp; H. *irregulare* (formerly known as "Pine type" *H. annosum* or *Fomes annosus*) is the species that infects pines.

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Figure 2. Decayed roots of 24" DBH Jeffrey pine which blew down in 2011, 95 feet from tree in Figure 1. (Taken January 2012)

fading Jeffrey pine in Figure 1 is 93 feet with a 36.8 inch DBH. It is growing on 20x50 foot patch of soil surrounded by asphalt-surfaced parking lot. It is likely this tree's roots were damaged by vehicles and heavy equipment before during construction of the asphalt parking lot. It is possible that it became infected with *H. irregulare* via root-to-contact with the 2011 blow-down tree (Figure 2). The tree in Figure 1 shows classic root disease symptoms: 1) slowly declining and thin crown (transparent foliage); 2) shortened needles with "lion's-tail" clumping of needles at branch tips; 3) branches dying in the lower crown; and 4) foliage slowly dying and disappearing from the interior of the crown.

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Within about 80 feet of the 2011 blow down Jeffrey pine are three "old" and two "very old" decaying pine stumps; one stump is 60 feet from the fading Jeffrey pine (Map1; Figures 3 and 4). The decay pattern in this stump is typical of that

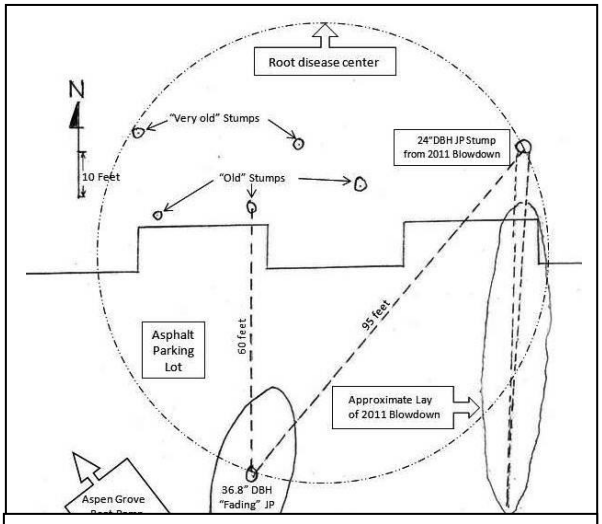

Figure 3. Old decaying pine stump (lower right corner) 60 feet from fading 36.8 inch DBH Jeffrey pine

Figure 4. Old decaying pine stump (Figure 3) showing decay typical of that resulting from *H. irregulare* infection.

caused by *H. irregulare.* The small pockets of decay in the sound wood show evidence of delaminating growth rings where the early wood decayed faster than the late wood. Also, when dissecting the stump, the decay was a 'white rot' like that caused by *Heterobasidion.* The 36.8 inch DBH fading Jeffrey pine (Figure 1) may have contracted root disease from this, the 2011 blow down tree, or another infected stump with which it had root contact; possibly the decaying stump 60 feet away.

In December 2012, wood was drilled from near the base of the 36.8" fading Jeffrey pine and from the exposed roots of the 2011 blow down Jeffrey pine stump and sent to the Matteo Garbelotto tree decay diagnostic lab at UC Berkeley for DNA analysis to detect decay fungi. The DNA of *Heterobasidion* was found in the roots of the blow down tree but not in the fading Jeffrey pine. These results confirm that the *Heterobasidion* fungus is present in the root disease center, but it has not yet reached the base of the 36.8" fading Jeffrey pine at the points sampled on the bole, about 4" above ground. When the fungus reaches this point in either a Jeffrey or ponderosa pine, the tree usually dies because the fungus girdles the stem.

Since most or all of a root decay fungus resides below the ground, it is unlikely that it will ever be detected before the tree blows over. With current technology, it is impossible to know how much of a tree's roots are weakened by root disease. Finding the decay would require digging up and testing a significant number of roots; thereby weakening or killing the tree.
The 2011 Jeffrey pine blow down had below ground decay in over 75% of its roots (Figure 2), and yet its crown appeared healthy. The crown of the 36.8" DBH fading Jeffrey pine pictured in Figures 1 and 3 does not look healthy. Its proximity to the known root disease center, in addition to having root disease symptoms, make 'root disease' a safe diagnosis. Regardless of whether-or-not the tree is infected with *H. irregulare*, whatever is causing its poor needle retention is weakening the tree and shortening its longevity. This tree could live ten more years or it could be uprooted by the next violent wind storm; it is impossible to know. Carefully falling this tree now would avoid potential injury or property damage and allow the healthy-looking Jeffrey pine regeneration growing under it to grow faster and reach maturity sooner; provided the regeneration does not also become infected.

Figure 5. Thinning crowns of the 36.8" fading JP (right) and several more JP just north of the "very old" decaying stumps (center).

It is important to note that three or more Jeffrey pine trees growing just north of the "very old stumps" shown on the map appear to also be infected with *H. irregulare*. The crowns of these trees, pictured in Figure 5, are becoming thin and transparent, one symptom of root disease. These trees are growing close enough to the decaying stumps to have acquired the disease through root contacts. These trees should be monitored to detect further loss of foliage and levels of decline which would warrant their removal.

Eagle Lake Ranger District is to be commended on its monitoring and mitigating the ongoing *Heterobasidion* root disease outbreaks in and around the recreation areas in the Jeffrey pine forests on the south shores of Eagle Lake. In addition, the District has been diligent in treating freshly cut conifer stumps with borate fungicides, known to prevent stump and root infections.

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The best control of *Heterobasidion* root disease is preventative stump treatment. Once the *Heterobasidion* fungus is established in roots, control can: 1) be very costly (removing all infected stumps and roots); or 2) take more than a quarter century (time required for the infected stumps and roots to completely decompose following the harvesting of all host plants and trees).

For more information on *Heterobasidion* root disease, see the attached. If you have any questions regarding this report and/or need additional information please contact Bill Woodruff at 530-252-6680.

/s/ Bill Woodruff
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Heterobasidion Root Disease

Heterobasidion spp. is a fungus that attacks a wide variety of woody plants worldwide. All western conifer species are hosts. Madrone (*Arbutus menziesii*) and a few brush species (*Arctostaphylos spp.* and *Artemisia tridentata*) are occasional hosts. Most hardwoods are apparently not infected. *Heterobasidion* root disease has been reported in all National Forests in California with incidence particularly high in true fir in northern California, in the eastside pine and in southern California recreation areas.

Heterobasidion root disease is one of the most important conifer diseases in Region 5. Current estimates are that the disease infests about 2 million acres of commercial forestland in California, resulting in an annual volume loss of 19 million cubic feet. Other impacts of the disease include: loss of tree vigor, increased susceptibility to attack by bark beetles, tree death, loss of site productivity, depletion of vegetative cover and increased probability of tree failure and hazard.

During periods favorable to the fungus, fruiting bodies (conks) form in decayed stumps, under the bark of dead trees or occasionally under the duff at the base of infected trees. New infection centers are initiated when airborne spores produced by the conks land and grow on freshly cut stump surfaces. In true fir spores also infect naturally-occurring and mechanical wounds. From infected stump surfaces the fungus grows into and through the roots, via root-to-root contact, to adjacent live host trees; resulting in the formation of expanding disease centers. A disease center can continue growing, host tree to host tree, until it reaches a barrier; such as an opening in the stand or non-host vegetation.

In pines, the fungus grows through root cambial tissue to the root crown where it girdles and kills the tree. In true fir and other non-resinous species, the fungus sometimes kills small trees, but more frequently is confined to the heartwood and inner sapwood of the larger roots; sometimes infecting the heartwood of the lower trunk. In all conifers, the fungus causes chronic decay and growth loss which predisposes infected trees to beetle attack and subsequent mortality.

Heterobasidion root disease in western North America is caused by two species: *Heterobasidion occidentale* (also called the 'S' type) and *H. irregulare* (also called the 'P' type). These two species of *Heterobasidion* have major differences in host specificity. *H. irregulare* ('Pine' type) is pathogenic on most pine species (but primarily on ponderosa and Jeffrey, sugar, lodgepole, pinyon and Coulter pines), incense cedar, western juniper, madrone and a few species of brush. *H. occidentale* ('Spruce' type) is pathogenic on true fir, Douglas fir, hemlock fir, spruce and giant sequoia. This host specificity is not apparent in isolates from stumps; with *H. occidentale* being recovered from both pine and true fir stumps. These data suggest that infection of host trees is specific, but saprophytic colonization of stumps is not. The fungus may survive in infected roots or stumps for more than a quarter century. Young conifers established near infected stumps often die shortly after their roots grow in contact with infected roots.

The best control for *Heterobasidion* root disease is prevention; i.e. treating freshly cut conifer stumps with a borate fungicide. The two fungicides registered for this purpose are SPORAX® (granular) and CelluTreat® (liquid). Once in the roots, *Heterobasidion sp.* can persist more than 25 years or until the roots decompose. As long as sound and wet wood, free of other microbes, is available, *Heterobasidion sp.* can survive. Therefore, the two primary controls for infected root systems are: 1) removing all host plants from the disease center for a quarter century, or until almost 100% of the roots have decomposed; or 2) removing all of the infected stumps and roots. The former may result in loss of site productivity and/or require managing only non-host trees on the site.

The latter is usually cost-prohibitive, except in nurseries, seed orchards, administrative sites, recreation areas or high-value sites.